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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/675,908	09/29/2000	Chun Huh	97.095	8977

7590 07/12/2004

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EXAMINER	
ROSALES HANNER, MORELLA I	

ART UNIT	PAPER NUMBER
2128	4

DATE MAILED: 07/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/675,908	HUH ET AL.	
	Examiner	Art Unit	
	Morella I Rosales-Hanner	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 September 2000*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 -18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 September 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/2/01*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

1. **Claims 1 - 18** are pending and have been examined.

Priority

2. The Office acknowledges Applicant's claim of priority over U.S. provisional application 60/159,035 filed on 11/12/1999.

Information Disclosure Statement

3. The information disclosure statements (IDS) submitted on 01/04/01 & 02/02/01 are in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statements are being considered by the examiner.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4.1 The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4.2 **Claims 1 – 18** are rejected under 35 U.S.C. 103(a) as being unpatentable over a printed publication by Wheeler et at. titled "A Parallel Multiblock/Multidomain Approach for Reservoir Simulation", hereafter referred to as *Wheeler* in view of **U.S Patent No. 6,152,226** issued to Talwani et al, hereafter referred to as *Talwani* in further view of **U.S. Patent No. 4,860,828** issued to Oswald et at. Hereafter referred to as *Oswald.*

As regards to **claims 1 – 18** *Wheeler* teaches **[Pg 6, Computational results Section]** an approach (method) for oil reservoir (hydrocarbon-bearing formation) simulation wherein water (fluid) is injected into the reservoir. This approach comprises:

- physical decomposition of the reservoir into at least one dimension to a multiplicity of grid cells **[Figs 1 – 4 and corresponding text]**;
- decomposing the physical problem in to sub domains over a single, appropriate hierarchical model describing the relevant physics, chemistry, geology, etc., (properties) on relevant time and space scales **[Pg 7, Conclusions]**;
- using appropriate hierarchical model describing the relevant physics, chemistry, geology, etc., (properties) on relevant time and space scales,

- constructing a model that manipulates descriptions of the sub domain problems as well as a description of the boundaries/ interfaces (regions) which include all geometrical and geophysical data, a choice of a physical/numerical model to describe the flow and transport in a given grid (energy transport);
- interfacing structured and unstructured grids [**Pg 1, Abstract**];
- decomposition offers great flexibility in accommodating the shape of the external boundary of an oil reservoir, the presence of internal features such as wells, and the need to refine a region of the domain in space or time;
- two-dimensional grids and three-dimensional grids [**pgs 2 – 3, Discretization Spaces section**]

Wheeler does not expressly teach:

- dividing the cells in a grid into two regions (swept and upswept),
- constructing a model representative of fluid properties within each region using principles of percolation theory,
- using a displacement fluid that is multiple-contact miscible with hydrocarbons present in the formation (claims 3 and 4),
- using carbon dioxide, gas or steam to displace the oil,
- a displacement fluid that comprises hydrocarbon gas,
- interfacial tension within each region, or

- transport rate between regions that is proportional to the driving force times resistance.

Talwani teaches:

- a system and process for oil recovery in which the boundary between the to-be-recovered hydrocarbon (unwept region) and the drive out (displacement) fluid (swept region) **[Col 3, lines 60 – 65]**;
- recovery involves re-pressurizing the reservoir with a fluid (i.e., a liquid or a gas) to lower the oil viscosity and/or drive the remaining crude oil in the oil-permeated layer to the surface through one or more wells and that the drive fluid is introduced into the reservoir by injection wells, which pump the pressurized drive fluid into the reservoir to displace and thereby drive the oil toward and to the producing wells (percolation) **[Col 1, lines 42 – 56]**;
- that oil recovery can be induced using pumps at the surface to extract oil or through depressurization (percolation) of the reservoir by injecting water, steam, or a gas such as carbon dioxide or nitrogen (miscible fluids) into the reservoir through injection wells **[Col 6, lines 38 – 50]**;
- In general, the gravity field along the z axis can be measured by uniaxis gravimeters of which a common type uses lasers and a high-precision clock to time a mass falling between two vertically spaced

points in an evacuated space and that gradiometers, as distinguished from gravimeters, measure the curvature gradients (or differential curvature or ellipticity of the gravity equipotential surfaces), horizontal gradients (or the rate of change of the increase of gravity in the horizontal direction), or vertical gradients (or the rate of increase of gravity in the vertical direction) **[Col 9, lines 32 – 41]** (transport rate between two regions);

- interfacial boundaries (between regions) are typically indistinct, althought, in some cases, the boundaries can be geologically distinct **[Col 6, lines 12 – 16]**; and
- that various devices and techniques used to interrogate sub-surface strata have led to significant advances in the ability to create a 3-dimensional model or simulation of the reservoir, however, existing sensing technologies are unable to detect the location and morphology of the boundary or interface between the pressurized displacement fluid and the oil or natural gas in those reservoirs undergoing secondary recovery and that information as to the position, morphology, and velocity of the boundary would be of substantial value in optimizing recovery of the hydrocarbons undergoing recovery, especially in efficient utilization of the displacement fluids.

Oswald teaches [**Col 6, lines 28 - 37**] that in miscible fluid operations, the gases employed are soluble with the reservoir crude oil under the temperatures and pressures within the formation and that carbon dioxide, mixtures of normally gaseous paraffinic hydrocarbons such as methane, ethane, propane or butane as well as normally gaseous olefinic hydrocarbons such as ethylene, propylene or butylene and mixtures thereof are most often advantageously employed in miscible flooding and finally, that mixtures of natural gas and liquefied petroleum gas (LPG) may also be used in miscible flooding. *Oswald* also teaches [**Col 2, lines 7 -10**] that in both the case of gas flood recovery and miscible fluid recovery, the gas or miscible fluid can be injected continuously and simultaneously with water in the same injection well or alternating with slugs of water. *Oswald* further teaches [**Col 1, lines 36 – 56**] that one common method of recovering oil is to contact the residual hydrocarbon with a miscible supercritical fluid.

Therefore in would have been obvious to one of ordinary skills in the art, at the time of the invention, to take the approach for multiphysics and multiscale simulation as taught by *Wheeler* and combine it with the process for oil recovery in which the boundary between the to-be-recovered hydrocarbon (unwept region) and the drive out (displacement) fluid (swept region) is detected and controlled as taught by *Talwani and* the common method of recovering oil using miscible fluids as taught by in *Oswald* in order to optimize recovery of the hydrocarbons undergoing recovery and the efficient utilization of the displacement fluids as taught by *Oswald*.

Additional Information

5. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Morella Rosales-Hanner whose telephone number is (703) 305-8883. The examiner can normally be reached Monday-Friday from 7:00 a.m. to 3:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska can be reached on 703 305-9704. The fax number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

MRH

June 10th, 2004

KEVIN J. TESKA
SUPERVISORY
PATENT EXAMINER